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THE ENVIRONMENTAL AND SOCIAL acceptability of dams

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KEYWORDS

- DAM
- HYDROELECTRICITY
- LOCAL POPULATION
- SOCIAL ACCEPTABILITY

Dams are an ever more vital tool for addressing our growing water needs and the emergence of new challenges such as sustainable development and climate change. However, these infrastructures are still highly controversial around the world. Citing numerous examples, this paper goes over the main points of debate around dams, and the necessary conditions for securing their acceptability.

INTRODUCTION

Planet Earth needs more and more water and more and more energy, due to growth in population and consumption, especially in developing countries. CO_2-emitting fossil fuel resources—hydrocarbons such as natural gas, oil and coal—are being consumed at a growing pace, and reserves are inevitably running out, to the detriment of future generations. Post-COP 21, the increased use of renewable energies is a necessity, reinforced by the Paris Agreement. The most economical of all renewable energies is hydroelectricity: it is competitive without costly subsidies, and without posing problems of storage or intermittent supply for electricity network operators. It also offers unique advantages for electricity network operation (frequency and voltage regulation).

Demand for fresh water, drinking water and water for irrigation will also greatly increase, with the projected change in climate. Without water, there can be no life on our planet. Fresh water resources are limited and poorly distributed. There are regions where the water supply is the absolute pre-condition for any improvement in standards of living—which are currently too low—and even for the survival of existing communities, as well as the satisfaction of the ever-increasing demand that results from the rapid growth in their population. Such regions cannot do without the contribution that dam-reservoirs make to the management of water resources. We will have to greatly increase our water resources and build new dams. Water storage infrastructures are seen to be indispensable tools both for sustainable development and for adjusting to climate change.

And yet the development of dams is controversial, in both the North and South, due to its potential impacts, and new projects often come up against (sometimes vigorous) opposition.

The social acceptability of dams is therefore a question of prime importance, and this paper seeks to outline some answers and lines of enquiry, concerning awareness of environmental and democratic issues, with examples of actions in developing countries.

1. THE DEBATE: THE BENEFITS AND DRAWBACKS OF DAMS

The main utilization of the world's great dams is for food production, by irrigating land that would otherwise be desert. California and Provence are good examples of how dams can transform a territory. Before: drought and desert. After: highly productive regions. The greater part of global demographic growth is happening in arid regions that need water to produce food, or in regions where rainfall is very irregular (monsoon lands), therefore requiring storage methods such as dams' reservoirs.

Hydroelectric energy, with a global output of 2,100 TWh, currently represents 20% of total electricity production and about 7% of all the energy consumed in the world. Hydroelectric dams facilitate adjustable electricity production, by storing huge quantities of water in their reservoirs.

Dams hold back river water. By means of turbines, they generate electricity from a renewable source with very few CO_2 emissions. This is hydroelectric energy production—"hydro" to its friends. Unlike wind or solar energy, hydro energy can be stored (in reservoirs) in order to generate electricity when needed, simply by opening the gates. This natural storage of energy is the most competitive form of power storage, making use of PSPSs (Pumped Storage Power Stations), which are crucial for electricity networks and play a key role in integrating other modern renewable energies (solar and wind) that are by nature intermittent.

In addition to producing clean carbon-free energy, dams can also, simultaneously, serve other functions: irrigating cultivated land, supplying communities with drinking water, reducing flood flows, replenishing low-water levels, aiding waterway navigation, using reservoirs for tourism and sports, fish-farming, protecting estuaries against tidal backup, and so on.

From an energy and climate viewpoint, dams are clearly very positive, and perhaps even represent the most advantageous of all renewable energies, provided that geography and hydrology allow for it.

But dams also have downsides: impacts on biodiversity, conflicts of use, risk of breach, and sometimes the displacement of local populations, arousing opposition. And indeed, every dam, hydroelectric or otherwise, blocks watercourses and constitutes an obstacle to the circulation of certain species (fish swimming upstream, notably migratory species such as salmon and eels) and sediments (sand, mud, etc.) which consequently build up and can concentrate pollutants in the reservoir. The absence of new sediments downstream of the dam can cause erosion problems that modify the aquatic environment, undercut riverbanks, or wash away beaches. Dams are therefore a double-sided coin, with a positive side (energy, drinking water, irrigation, flood regulation, river navigation, fight against drought, etc.) and a negative side (ecology, sediments).

Cantoniera dam, on the Tirso, essential to Sardinia's water supply (photo: ICOLD-CIGB)

HYDROELECTRIC ENERGY IN THE WORLD:

Generates
2,100 TWh

20%
of total electricity production

7%
of all the energy consumed

2. DAMS AROUND THE WORLD

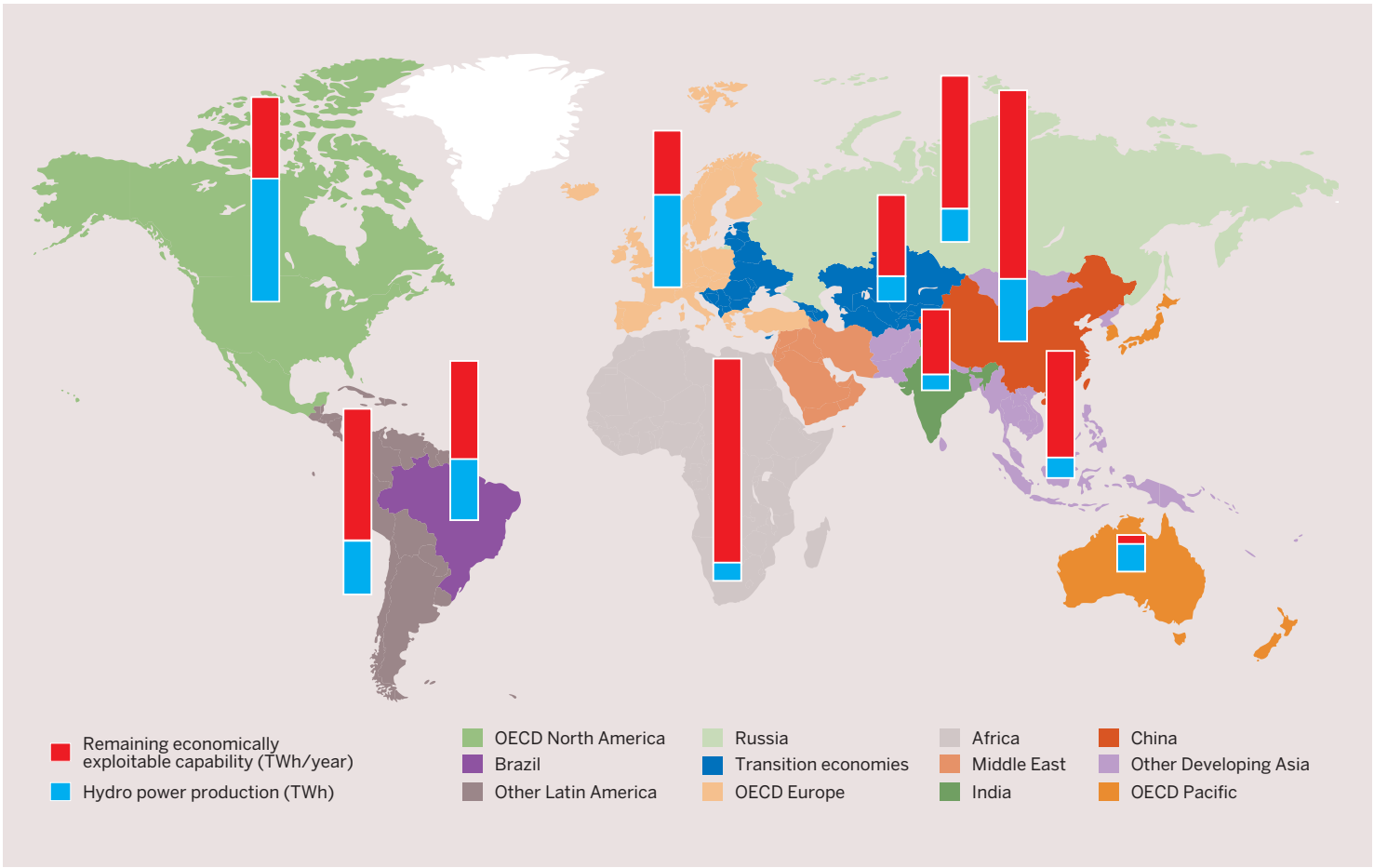
The map below presents, schematically, the potential hydroelectric power capacity in the various regions of the world. The blue vertical bars represent existing hydro production, and the red bars the economically exploitable capability. It is clear at a glance that North America and Europe have already exploited almost two thirds of their capacity, but that Asia, Latin America, and above all sub-Saharan Africa, still have enormous potential for renewable hydro energy that remains to be developed.

In the USA, major dam programs were built during the New Deal: the Tennessee Valley Authority (TVA), the Columbia River Basin, etc. They played a fundamental role in the development of the country's interior. Prior to the TVA, the Tennessee valley was still under-developed, with a population marked by high rates of illiteracy and ravaged by malaria. Hydro is the largest source of clean electricity in America, accounting for 51% of all renewable energy production in the USA. However, environmental concerns are growing, and it is becoming very difficult to create new facilities: very little hydroelectricity has been brought on stream in the USA over the last 20 years. Although President Obama announced his intention to relaunch the program, the construction of new hydroelectric dams in the USA is currently limited for several reasons: the best sites are already developed, clashes with protesters over environmental issues are increasing, and restrictive regulation is scaring away investors who might be interested in hydro, as the licensing process becomes ever longer and more difficult. Increases in hydroelectric capacity are therefore limited mainly to reinforcing and improving existing structures.

In Canada, Hydro-Quebec has developed large dams in the North, in James Bay, a highly profitable source of electricity, which is partly exported to neighboring regions and the USA. In China, the country with the world's fastest growing economy, mounting energy needs are driving an ambitious program: more than 50 major dams were planned in the 12th five-year plan (2011-2015) to achieve the 15% renewable energy target in China—the world's leading greenhouse gas emitter—by 2020.

China has, by far, the largest hydroelectric potential in the world.

Since July 2012, the famous Three Gorges Dam has reached full power at 22,500 MW, the current world record (a capacity equivalent to more than a dozen nuclear reactors or some thirty coal-fired power stations). More than 1.2 million people were resettled, and more than a hundred towns and villages disappeared under the waters of the Yangtze. It is worth remembering that the main motivation for building the dam was not electricity production but rather to combat the violent floods to which the Yangtze was prone, which regularly killed thousands of victims (100,000 dead in 1911, 145,000 dead in 1935, 33,000 dead in 1954) and left hundreds of thousands of homes destroyed and families with nowhere to live.



The new Xiluodu Dam, a 278-meter-high arch dam, has been linked to a 13,860 MW hydroelectric power plant since 2014, making it the second largest hydro dam in China after the Three Gorges Dam (and the third in the world after Itaipu, in Brazil-Paraguay). 180,000 people were displaced.

In Egypt, the great Aswan Dam on the Upper Nile, built by the Soviets in the 1960s without any environmental impact study, has unfortunately had negative consequences, holding back the sediments of the Nile that build up and clog the reservoir, and are sorely missed in their role of providing fertilizing silt for the floodplains of the Nile. Since its construction, however, Egypt has avoided the famines that had afflicted the country regularly for centuries.

In sub-Saharan Africa, where the rate of electrification remains very low despite an explosion in demographic growth, there is an enormous hydroelectric potential to be developed. One need only look at the dams of Manantali (Mali, Senegal, Mauritania), Garafiri in Guinea, "Renaissance" in Ethiopia, on the Upper Nile, Ruzizi 3, the Zambezi...

The Grand Inga Project is worth particular attention: on the Congo river, downstream from Kinshasa, it will generate almost 40,000 MW of background hydro power throughout the year (almost twice as much as the Three Gorges) thanks to a exceptional site with a "zigzag" shaped head of 80 meters and a huge flow rate in "run-of-river" configuration, with no large backed-up reservoir, thus limiting the environmental impact, and making the cost per kWh produced and delivered extremely competitive. The potential capacity far exceeds the needs of the DRC, but South Africa is interested in the project, which would enable it to reduce its dependency on coal; moreover, part of the vast energy of the Grand Inga Project is to be devoted to an "Energy for Africa" program. There are many other sites that could be developed in Africa, and projects that could be financed within a renovated institutional framework that allows investors to participate in public-private partnerships.

2.1. A RECENT EXAMPLE: THE NAM THEUN DAM

The **Nam Theun project,** a dam in Laos that supplies power to Thailand, strives to be the model of a successful project: creating local wealth while preserving natural resources, providing access to water, and regulating the course of the river while reducing greenhouse gas emissions. An exemplary program has been put in place to resettle local communities.

The sustainable development of dams (complying with the criteria defined by the World Bank and with the CIGB guidelines) is indispensable for access to energy in developing countries. It resolves problems of drought and river regulation, as well as access to energy, without using fossil fuels, and is a far more regular and reliable renewable energy source than wind. The only requirement is that we define ground rules that are valid in the long term and which preserve the environment, by means of detailed and credible impact studies.

2.2. A FRENCH EXAMPLE OF ACCEPTABILITY ULTIMATELY ACHIEVED: THE TIGNES DAM

France's highest dam, the 180-meter high **Tignes Dam**, was for a long time Europe's highest dam. Situated in the Chevril valley on the Isère river, it is a beautiful, curved arch dam.

But this large-scale project had a very bumpy ride... When it was launched, in 1948, the project came up against strong resistance from the local population. The inhabitants took the case to court, seeking to obtain the annulment of the decrees declaring the dam project to be in the public interest, and contesting the offered amount of compensation for expropriation. The building of the dam and the creation of the reservoir, the artificial Lake Chevril, submerged the village of Tignes and five hamlets. At the time, there were even some attempts to sabotage the construction. The lake eventually engulfed the village, its church, and its cemetery. Four hundred people were displaced when the dam was built, and rehoused in the new modern village of Les Boisses built a few kilometers from the historic Tignes (and which is now a well-known ski resort).

"IT WOULD BE FAIR TO SAY THAT DAMS EMBODY A CONTRADICTION: GLOBALLY, THEY HAVE MANY ADVANTAGES, BUT LOCALLY—ESPECIALLY FOR LOCAL POPULATIONS—THE ADVANTAGES ARE OUTWEIGHED BY DRAWBACKS."

Despite the fierce local opposition at the time, the dam addressed a real national need: after the Second World War, there was no choice but to build new electricity production infrastructure in order to meet the large rise in electricity demand.

70 years on, Tignes is well-integrated into its environment, and a successful example of both social acceptability and regional development.

3. THE DIFFICULTY OF GAINING ACCEPTANCE FOR DAMS TODAY

In France today, would it be possible to build a dam project such as Tignes, engulfing villages and hamlets? It seems unlikely, given the strong emotional and even violent opposition to small-scale dam projects, such as the simple irrigation reservoir at Sivens in the Tarn valley, which regrettably led to violent clashes in October 2014 between anti-dam protesters and the police, and in which an environmental activist was killed.

It would be fair to say that dams embody a contradiction: globally, they have many advantages, but locally — especially for local populations — the advantages are outweighed by drawbacks: flooded land leading to dispossession and discontent, thus requiring assessment and compensation.

More broadly, a structural opposition emerges between the *public interest,* which is situated at a wider territorial level—perhaps national or even planetary—and *local interests,* rooted in the areas directly concerned by each dam and reservoir project.

Yet acceptance must be found at every level, global and local. In the past, and particularly in developing countries, there were cases of so-called "white elephant" dam projects that paid no regard whatsoever to local realities. These dams—often associated with mining operations—contributed to some extent to industrial development, thanks to the electricity generated, but were of no benefit to the

populations affected by their construction. In some cases, local communities were still without electricity 20 years after the dam was built. This local level is now more important than it used to be, with less central government control, and more local power devolved to "civil society".

In the case of the monumental Three Gorges Dam, more than a third of the total budget is estimated to have been allocated to operations designed to compensate affected populations.

Dams have a critical geographical component: they can only be located in geographically favorable sites, with a strong head of water: a good gradient and an adequate flow of water in the river. Such sites are often inhabited. It is important to bring local populations in on the project, in all of its aspects, not least its cultural and sociological components.

Today, potential hydro sites (typically in mountain valleys) are often a long way from the centers of consumption; the electricity therefore has to be transported over large distances, or even between countries, such as Laos and Thailand for the Nam Theun project. Good cooperation is required between countries, as well as stability to limit the risk taken by investors. Very large-scale projects are the most complex of all. When it comes to acceptability, in certain cases "small is beautiful".

At the global level, non-governmental organizations (NGOs) opposed dams in the 1990s, demanding the abandonment of funding for large dam projects, sparking controversy. The World Bank, previously one of the main backers of dam projects in the third world, had halted almost all funding during the 1990s, preferring to focus on telecommunications. In May 1998, in response to the controversy over large dams, it set up—jointly with the International Union for the Conservation of Nature—the "World Commission on Dams" (WCD), which published its report in November 2000. The report was given a lukewarm reception.

While there was general agreement on the five core values and the seven strategic priorities set out by the WCD, the dam experts representing ICOLD expressed strong reservations about the policy principles and guidelines proposed in the report. The anti-dam NGOs, by contrast, welcomed the WCD report with joy and treated it as gospel, and beyond dispute. Time has delivered its verdict: according to professor John Briscoe[1] from the Harvard School of Engineering, *"... [the WCD] was over since it published its final report. At that time, none of the large dam-building nations supported it and nobody used it since then to build a dam."*

The Trängslet Dam in Sweden (photo: ICOLD)

Given these facts, and the growing influence of emerging countries at the World Bank, the latter revised its stance on dams. This radical change took the form of a New Water Sector Strategy, adopted in 2003. At the same time, the Bank's departments were working on guidelines for better addressing the environmental and social impact of large dams. These enabled the financing of hydro projects in developing countries to resume.

Recently, Rachel Kyte, speaking as the World Bank's Vice President and Special Envoy for Climate Change at the Global Water Forum, went so far as to assert that *"as we move toward green growth, large-scale water infrastructure has an essential role to play"*. And the World Bank has begun to fund feasibility studies on large dams again, on the condition that its environment guidelines are followed.

Dam builders therefore had to expand their criteria for assessing projects. In addition to the three classic criteria of technical, economic and financial feasibility, dam projects must now meet a fourth, very demanding, criterion: that of their acceptance by the public and by elected representatives. This criterion has become as important as the safety criterion.

Beyond the environmental question in the strictest sense, there is a social aspect, one that touches on a broader meaning of the word "environment": people, their land, their habitat, their economies and traditions. The impact of dams and reservoirs on this environment is inevitable and undeniable; land is flooded, people are resettled, the continuity of aquatic life along a river is interrupted, and the water flow is modified and often reduced by catchments. Thus, dam engineers find themselves confronted with the basic problems inherent in transforming the natural world into a human environment. In our never-ending quest to provide a growing number of people with a better life, the need to develop natural resources, including water, means that the natural environment cannot be preserved completely unchanged. But great care must be taken to protect the environment from all avoidable harm or interference. We must cooperate conscientiously with nature's inherent fragility as well as its dynamism without ever overtaxing its powers of regeneration, and its ability to adapt to a new but ecologically equivalent equilibrium. And we must ensure that the people directly affected by a dam project are better off than before.

Today, the process of building a dam is very different from what it was in the 1960s, when the engineer was in sole command. The economist and the financier took their place on the project team during the 1970s and 80s. More recently, since the first UN Environment Conference (Stockholm, 1972), the enormous increase in human knowledge, particularly in the field of environmental science, means that a whole

1 Shortly before his death in November 2014, John Briscoe was awarded the Stockholm Water Prize for his work in support of development.

team of specialists is needed to access and utilize that knowledge for any water resource development project. This multidisciplinary approach is better able to encompass the full complexity of this type of project.

The larger the project, the greater the effects on the natural and social environment, and the wider the scope of the multidisciplinary studies that will be needed. Large-scale dams require integrated planning for an entire river basin before any construction projects are implemented. Where river basins are part of more than one country, such planning presupposes international cooperation.

Involuntary resettlement must be handled with special care, managerial skill and political sensitivity based on comprehensive social research, and sound planning for implementation. The associated costs must be included in the comparative economic analyses of alternative projects, but should be managed independently to make sure that the affected population will be properly compensated. For the communities involved, resettlement must result in a clear improvement of their living standards, because the people directly affected by a project should always be the first to benefit, instead of suffering for the benefit of others.

Special care must be taken for vulnerable ethnic groups. Hence, the organization of the overall decision-making process, incorporating the technical design as a sub-process, should involve all relevant interest groups from the initial stages of project design, even if the existing legislation does not (yet) demand it.

Such concerted action requires continuous, comprehensive and objective information on the project to be provided to governmental authorities, the media, local action committees and NGOs, and—above all—to the people directly or indirectly affected, and their representatives. In this transfer of information from planners to public, dam engineers must contribute, through their professional expertise, to a clear understanding and dispassionate discussion based on facts, and not on emotive ideas about the positive and negative aspects of a project and its possible alternatives. Dam promoters must act as mediators and educators in order to win acceptance.

Kurobe Dam, in Japan, is designed mainly to combat flooding (photo: ICOLD-CIGB)

CONCLUSION

Are dams a benefit, a valuable water and renewable energy resource? Or a necessary evil?

There is a growing awareness among certain NGOs specializing in development that well designed, well-built dams can be effective instruments of sustainable development.

Conversely, in "democratic" countries, it is becoming increasingly difficult to implement large-scale projects (power lines, high-speed rail lines, dams... even wind projects). These meet with strong opposition, even giving rise to defense committees.

So many questions, for which there is no single answer — and no one-size-fits-all model. When it comes to the demand for energy in the field, multiple factors — technical, financial, institutional and psychological — come into play. Social acceptability is imperative. We must remain concrete and pragmatic: a multitude of micro-decisions is involved. Although the sheer multiplicity of actors can make partnerships complicated, it is important that these are developed, thus combining and integrating the know-how and value of the contributors — public sector, private sector and market forces — and setting up local companies to run and maintain the installations and market their services over the long term.

We believe that to be effective in meeting the huge energy, environment and sustainable development challenges that lie ahead, the cooperation of all of the actors will be needed for a long time to come, in particular that of the users and communities concerned, through a continuous effort of learning and education. The answer surely lies in successful implementations in the field, close to local populations, in a way that is innovative, sustainable and reproducible, creating a virtuous circle of progress.